

## CHOLECYSTOGRAPHY—ITS VALUE AS A DIAGNOSTIC PROCEDURE

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[Note—The Editorial Councilor, who evaluated this discourse for the editor, pronounced it "a distinct and valuable contribution to medical science," to which the editor would like to add that it is also a contribution to medical literature.—EDITOR.]

*We feel that in tetraiodophenolphthalein we have a safe and reliable method of studying some of the functions of the biliary system.*

*Failure of visualization indicates disturbed function, usually the result of definite pathological processes in the gall-bladder or cystic duct. Such cases we have considered essentially surgical, provided there was no conflict in the assembled findings.*

*Incomplete visualization after the intravenous method indicates some disturbance in biliary tract function, which may be due to pathological processes in cystic duct or gall-bladder. We have felt inclined to watch these cases on medical treatment for a time before advising surgery.*

*Normal visualization indicates a fairly normally functioning biliary system, which, however, does not exclude slight pathological processes, but would certainly seem to contra-indicate any surgical procedures, except with the most definite clinical indications.*

*Caution and experience are necessary in interpreting the results, especially after the oral method. Above all, these findings must be correlated with the clinical findings.*

**C**HOLECYSTOGRAPHY, the visualization of the gall-bladder by the oral or intravenous administration of certain of the phthalein dyes, is a valuable diagnostic procedure and worthy of more general adoption.

Those interested in the development of the test are referred to the earlier papers of Graham, Whitaker, and Carmen. For our present purpose it will suffice to recall the following facts upon which the test depends. First, the sodium salts of tetrabrom and tetraiodophenolphthalein are taken from the blood by the liver and excreted in the bile. Second, because of the bromine and iodine ions contained in these salts they offer marked resistance to the passage of x-rays even in relatively dilute solutions. Third, the gall-bladder concentrates and stores the freshly secreted liver bile during the inter-digestive periods. Fourth, because of this concentrating and storage function of the gall-bladder, the density of its contents is so increased after the administration of either one of these salts that beautifully sharp radiograms of the gall-bladder are obtainable.

Successful visualization of the gall-bladder by this method is thus dependent upon: (1) A sufficient concentration of the dye in the blood; (2) a liver capable of excreting the dye at a fairly normal rate; (3) a patent cystic duct, allowing the entrance of freshly secreted bile to the gall-bladder; (4) a gall-bladder whose walls are sufficiently elastic to allow for the expansion and contraction necessary for gradual filling and emptying; (5) a gall-bladder capable of concentrating its contents; (6) a gall-bladder whose lumen is not filled with stones; (7) a patent common duct; and (8) a sphincter of Odi that closes the common duct during the inter-digestive periods. Given all these conditions, a satisfactory visualization should always be obtained; on the other hand, a disturbance of any one or more of these conditions may result in a partial or complete failure.

The blood concentration after the intravenous administration of the dye in the usual dosage is always sufficient, but with the oral administration there is introduced the uncertain factor of intestinal absorption. However, from the evidence at hand, it seems probable that failure, due to faulty intestinal absorption, will be of infrequent occurrence. The functional efficiency of the liver must always be kept in mind, but with the large factor of reserve, failure due to this cause should be infrequent and readily recognized. An obstruction of the cystic duct, organic or functional, will naturally result in a complete failure. Again, a gall-bladder with walls thickened and inelastic offers little opportunity for the entrance of the dye-containing bile, and therefore should give no shadow, or, at best, but a faint shadow. Similarly, a gall-bladder incapable of concentrating its contents should cast but a faint shadow or none at all. If the lumen of the gall-bladder is filled with stones it is evident that the concentration of the dye will be insufficient to cast a sharp shadow, and we should expect either no shadow or a faint mottled shadow. An obstruction of the common duct below the cystic duct would seem to promise a failure because of the inability of the dye to get into the already overfilled gall-bladder. Finally, recalling that the gall-bladder fills when the sphincter of Odi is contracted, it seems probable, on theoretical grounds at least, that a temporary or permanent relaxation of this sphincter would be followed by a partial or complete failure of visualization. From this, satisfactory visualization would seem to indicate a fairly normally functioning biliary system, partial or complete failure of visualization, a disturbance of function which should usually be found in the cystic duct or gall-bladder.

The intravenous method of administering the dyes was first used and has the advantage of absolute accuracy of dosage. The disadvantages of the intravenous method are that it usually requires hospitalization, that it calls for rigid asepsis, that there is at times objection to, or at least question about the injection of a considerable quantity of a highly colored solution, and finally that sharp reactions during or following the injection may occur. This last difficulty was encountered in about half the cases when using the tetrabromphenolphthalein, but happily is very infrequent and of very mild degree with the tetraiodophenolphthalein.

On the other hand, the oral administration has the advantage of not requiring hospitalization nor special technique of administration. It arouses little fear in the patients, and although reactions are occasionally encountered they are usually slight and of short duration, consisting of abdominal distress, occasional nausea and vomiting, and sometimes diarrhea.

These advantages clearly make the oral method more generally applicable, and in our later work this has been the method of choice. However, for the present, at least, we feel it advisable to re-examine with the intravenous method all cases failing to visualize by the oral method. By this means we eliminate intestinal absorption as the cause for the failure and place the trouble definitely in the biliary system. Eventually, it may be proven that

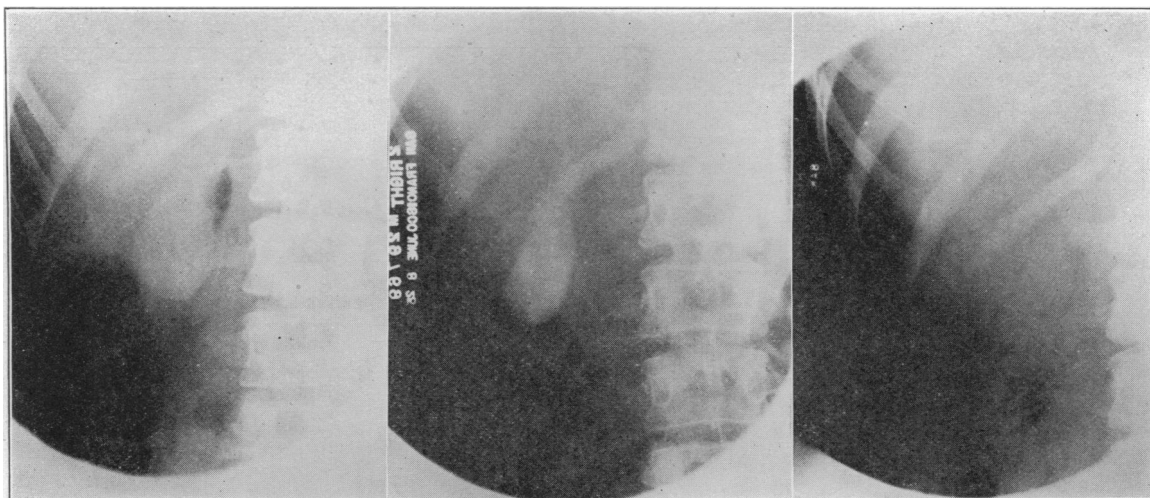


Plate 1. Normal gall-bladder four hours after intravenous injection of tetraiodophenolphthalein.

Plate 2. Normal gall-bladder nine hours after intravenous injection of tetraiodophenolphthalein.

Plate 3. Normal gall-bladder twenty-four hours after intravenous injection of tetraiodophenolphthalein.

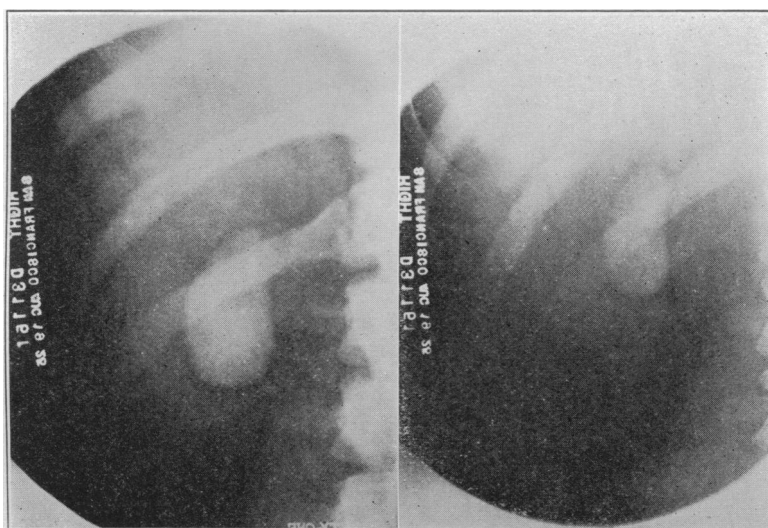


Plate 4. Normal gall-bladder fourteen hours after oral administration of tetraiodophenolphthalein.

Plate 5. Normal gall-bladder eighteen hours after oral administration of tetraiodophenolphthalein.

this precaution is not necessary, but until such a time our present routine seems indicated.

For the oral method we followed the plan proposed by Whitaker. The patients are given enteric coated pills of tetraiodophenolphthalein in the proportion of one pill for every ten pounds of body weight, with twenty pills as a maximum. As the pills contain 300 mgs. each, this makes a maximum dosage of 6.0 grams. They are also given the following instructions: (1) At 6 p. m. eat a light supper without meat; (2) starting at 8 p. m. take four pills with half a glass of water every half-hour until all pills are taken; (3) while taking the pills, and from then until going to sleep lie on the right side, taking half a glass of water every half-hour; (4) do not break the pills; (5) take no physic; (6) take no food until directed to; (7) report at the x-ray laboratory at 10:30 a. m.

At this time plates of the gall-bladder region are taken, and it is desirable to include one of the entire

abdomen, as this will show the number of pills undissolved and give an approximate idea of the quantity of the dye remaining unabsorbed. Three hours later a second set of plates are taken, after which a full meal is given. Two hours later the final examination is made.

Graham has recently reported the administration of tetraiodophenolphthalein in capsules coated with phenyl salicylate, the dose averaging 0.07 gm. per kilo of body weight, or about 5 gms. for the average adult. This dose is divided into five capsules, which are administered during the evening meal at 6:30 p. m. Food is withheld until after the films are made at 9 a. m. and 1 p. m. the following day. After these films a glass of milk or cup of coffee is given

and further films taken at 5 p. m., and in some cases at 9 a. m. the next day, the regular evening meal being allowed. Water is allowed as desired after taking the drug. This routine is more readily followed than Whitaker's, and we have recently adopted it, although still using the enteric coated pills developed by Whitaker.

For the intravenous method 2.5 to 3.5 mg. of tetraiodophenolphthalein dissolved in 30 cc. double-distilled water and sterilized in boiling water for forty-five minutes or the autoclave for thirty minutes is injected into the median cephalic or the basilic vein. With the tetrabromphenolphthalein it was advisable to administer it in divided doses, but this is unnecessary with the tetraiodophenolphthalein. The patients are instructed to remain in bed and to refrain from food. Plates are taken four, nine, and twenty-four hours after the injection. Food is allowed after the nine-hour examination,

and, if desired, films may be taken an hour or two after this meal.

In examining these plates it is found that after the intravenous method the four-hour films normally show the gall-bladder as a fairly large, smoothly outlined, moderately dense shadow. In the nine-hour films there is an increase in the density of the shadow, but a decrease in the size. Films taken after a meal show a decrease in both size and density, and finally the twenty-four-hour films show either no shadow or a small irregular faint shadow. It is thus possible to study the size, shape, position, and emptying of the gall-bladder, as well as the variations in the density of the shadow. With the oral method we are able to study the same items, but with less exactitude.

In reviewing the results, the cases fall naturally into three main groups:

First. The cases giving a perfectly typical reaction, as previously described. This indicates a biliary tract that is functioning normally, and although it does not exclude slight pathological changes, would seem to exclude gross abnormalities.

Second. The cases in which there is a complete failure of visualization. This negative evidence, especially after the intravenous method, is of the greatest value and indicates a marked disturbance in biliary tract function. This disturbed function is usually the result of definite pathological processes in the gall-bladder or cystic duct—cholecystitis, cholelithiasis or cystic duct obstruction. However, the possibility that spasm of the cystic duct or relaxation of the sphincter of Odi may produce such a failure must be kept in mind.

Third. The cases in which there is an incomplete visualization. Under these we would group the cases in which the density of the shadow seems insufficient, those in which there is no evidence of increased density between the first and second examinations, or in which there is no change in the size of the shadow in the various films, or in which there is either rapid or delayed emptying. Any or all of these findings result from disturbed function of the biliary tract and are probably dependent upon moderate pathological processes. However, until we have had considerable experience caution is advisable in interpreting these variations, especially if the oral method alone is used.

The size, shape, and position of the shadow are of interest, but apparently of little diagnostic importance, and vary with different body types. Irregularities in the contour of the shadow may be of some value in indicating adhesions or pressure. Variations in the density of the shadow may result from stones, papillomata, overlying gas, calcified glands, etc., and must, therefore, be interpreted with caution.

We have used the test in 109 cases up to this writing; in four the dye was given rectally, thirty-eight by mouth, and sixty-seven intravenously. Rectal administration was soon abandoned, as the degree of absorption was too uncertain and considerable rectal irritation was produced by the dye. Of the thirty-eight who received the dye by mouth, seventeen gave normal visualizations, eleven incomplete, and ten no shadows. In this group five cases have been operated upon, three of whom gave no

shadow, and two incomplete visualizations. In all five there was definite pathology in the gall-bladder. Of the sixty-seven intravenous cases, fifteen gave normal reaction, twenty-six incomplete, twenty-five no shadows, and one suffered so severe a reaction with the tetrabromphenolphthalein that no films were taken. Of this group fifteen have been operated upon, seven having given no shadow, seven incomplete shadows, and one a normal shadow. In this latter case there was a definite chronic appendicitis, but the changes in the gall-bladder were very slight. Of the remaining fourteen cases, all showed definite pathology. One was especially interesting in that, although there was no shadow on any of the films at operation, the duct was patent and the wall and mucous membrane practically normal, but there was a solitary stone about 1 cm. in diameter in the gall-bladder. Here the failure in visualization resulted, not from an organic obstruction of the cystic duct, marked thickening of the gall-bladder wall, nor disturbed function of the mucous membrane, but apparently from a reflex spasm of the cystic duct, or a reflex relaxation of the sphincter of Odi produced by the presence of the stone.

Of the unoperated cases, the findings by this method have closely paralleled the conclusions reached by the other methods of study. We hope to keep these cases under observation and report more completely at a subsequent time.

We are convinced that the evidence furnished by this method is, in the majority of cases, more definite and reliable than that furnished by the other special methods of examination. Thus, the indirect and direct evidence of gall-bladder disease noted in the routine barium meal study, the demonstration of a shadow of a supposedly thickened gall-bladder, and the findings by the Lyon's method, although of value, have in our experience been less dependable. Of course, the occasional demonstration of undoubted gall-stone shadows is very convincing, but many stones fail to give convincing shadows, and also many cases of biliary tract disease are uncomplicated by stones.

Here it should be emphasized that no special method of examination should be solely relied upon in arriving at a diagnosis, and the findings by this test must naturally be correlated with the findings resulting from careful clinical study, history, physical examination, etc.

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"The physician is in charge of the patient," concludes a report of the Associated Out-patient Clinics of New York. "It is his responsibility to diagnose the disease and to prescribe treatment. He is the head of the unit organized for the benefit of the patient; the social worker is a part of this unit. Working with the physician, fitting her specific qualities into the plan of action, the social worker reaches her greatest usefulness to the patient. Working alone, touching the physician only casually, she cannot function to the best advantage. It is, therefore, highly important that, for the exercise of her primary duty 'to further restoration and maintenance of health', she work under the immediate direction of the physician. It is equally important that the physician should outline the principles for the social worker to follow."

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Choose rather to punish your appetites than to be punished through them.—Epictetus.